SECTION 5.0

OPERATIONAL SCENARIOS

The advent of data link communications provides the opportunity and the challenge to overcome the current deficiencies and meet the future needs of communication and dissemination of ATS and FIS services and products throughout the future air/ground communications system. A clear understanding of user issues and operational scenarios is essential to ensure that all of the benefits for both FAA operators and system users are attained. This section includes descriptions of Future Digital VHF A/G Communications System and operations for:

- System operators performing roles in all operational domains
- System users conducting missions in all operational domains
- Capabilities envisioned for voice communications, addressed data link and broadcast data link communications
- Support environment scenarios

5.1 Operational Environments and Users of the A/G Communications System

The focus of the description of the scenarios is toward the visualization of how the new A/G communications system will operate and be used by controllers, specialists and pilots. Subsequent sections provide a detailed description of the user operations in all NAS operational environments: tower/airport surface, terminal area, domestic en route, oceanic, flight services, and national traffic flow. Figure 5-1 depicts the operational environments in which the future A/G communications system operates, and the operators (controllers) and users (pilots) of the system within each environment.

Figure 5-1. Operational Environments and Users of the A/G Communications System

The following sections provide a more in-depth description of each environment, the types of A/G communications services required, and related operations performed by various users of the operational environment. Operator and user scenarios depicting typical handling of flights within the NAS future A/G communications system are also provided as an example of future air/ground communications operations.

5.2 Current A/G Communications System Features

Current A/G communications system features related to ATC radio and interphone communications procedures, as required for ATC, are common to all operational domains. These procedures are extensive and are described in the FAA Air Traffic Control Handbook, 7110.65, Section 4. The basic communications functions will not change; however, the methods used to conduct controller-to-controller and controller-to-pilot communications will be very different as the digital A/G communications system evolves. These ATC A/G radio communications practices which are supported by the current A/G communications system features include:

ATC Function/Duty	ATM Handbook Reference
Radio Communications	Paragraph 2-70
Monitoring	Paragraph 2-71
Pilot Acknowledgment/Readback	Paragraph 2-72
Authorized Interruptions	Paragraph 2-73
False or Deceptive Communications	Paragraph 2-75
- Phantom Controller	
- Correction to Message	
- Broadcast Alert	

Authorized Relays	Paragraph 2-76
Radio Message Formats	Paragraph 2-77
- A/C Identification	
- Identification of ATC Facility	
- Message	
Abbreviated Transmissions	Paragraph 2-78
Priority Interruptions	Paragraph 2-80
Words and Phrases	Paragraph 2-83
Emphasis for Clarity	Paragraph 2-84

All of these ATC communications features will be supported and improved as a result of the implementation of the Future Digital VHF A/G Communications System. The following section describes how the new A/G system will employ new features to assist controllers and pilots in the air-to-ground communication of ATC and information transfer using both voice and data communications.

5.3 Future A/G Communications System Features

In Section 2.0, a description of the Future Digital VHF A/G Communications System was provided which included discussion of the radios, voice and data communications capabilities which would be available to controllers and pilots using the new system. Table 5-1 applies these features to the ATC functions and the methods which will be used in the future to perform required A/G communications. In addition, the table provides a comparison between current methods and future methods. In subsequent sections, these features are graphically depicted in scenarios showing applications from three perspectives by operational domain, system operators (controllers) and system users (pilots).

Table 5.1. Applicability of Future System Features to Current ATC A/G Communications Functions

ATC Function/Duty	*Current Method*	*Planned Method (New A/G Features)*
Radio Communications	Voice Only (headset/speaker)	Voice • Transfer of Communications • Automatic Channel Management • Selective Addressing • A/C Identification (Caller ID) • Headset/Speaker Data Link • Two-Way • Broadcast
Monitoring		Voice • Automatic Channel Management • Channel Contention Limitor • Headset/Speaker Data Link • Two-Way • Broadcast
Pilot Acknowledgment (Readback)		Voice • Selective Addressing • A/C Identification/Caller ID • Channel Contention Limitor • Headset/Speaker Data Link • Two-Way
Authorized Interruptions		Voice • Headset/Speaker Data Link • Two-Way • Broadcast
False or Deceptive Communications		Voice • Link Failure Detection • Link Security • Controller Override • Headset/Speaker Data Link

		• Two-Way • Broadcast
Authorized Relays		Voice • Headset/Speaker

Table 5.1. Future A/G Communications System Features, Continued

ATC Function/Duty	***Current Method***	***Planned Method (New A/G Features)***
Radio Message Formats		Voice • A/C Identification (Caller ID) • Facility ID • Headset/Speaker Data Link • Two-Way • Broadcast
Abbreviated Transmissions		Voice • A/C Identification (Caller ID) • Headset/Speaker Data Link • Two-Way
Priority Interruptions		Voice • Controller Override • Pilot Urgent Message Indicator • Headset/Speaker Data Link • Two-Way
Words and Phrases		Voice • Headset/Speaker Data Link • Two-Way • Broadcast
Emphasis for Clarity		Voice • A/C Identification (Caller ID) • Selective Addressing • Headset/Speaker Data Link • Two-Way

Important features will be available to controllers and specialists to improve the reliability and timeliness of communication with pilots. While some of these features are still in the early phase of conceptualization, a few have been identified for implementation in the future A/G communications system. These features, which were described in Section 2.0, include:

- Transfer of Communications
- Reduction of Stuck Microphone Incidents
- Reduction of Clipped and Blocked Transmissions (Controller Override)
- Selective Addressing
- Link Failure Detection and Correction
- Link Security
- Aircraft Identification (Caller ID)
- Pilot Urgent Message Indicator
- Channel Contention Limitor

Descriptions of these features are provided in Section 2.0. Graphic representations of new functions for individual communications control events are presented in the following nine illustrations:

Figure 5-2. Transfer of Communications
Figure 5-3. Reduction of Stuck Microphone Incidents
Figure 5-4. Reduction of Clipped and Blocked Transmissions (Controller Override)
Figure 5-5. Selective Addressing
Figure 5-6. Link Failure Detection and Correction
Figure 5-7. Link Security
Figure 5-8. Aircraft Identification (Caller ID)
Figure 5-9. Pilot Urgent Message Indicator
Figure 5-10. Channel Contention Limitor

In addition, the specific application of these features is described as part of the two operational scenarios included in Sections 5.6.1 and 5.6.2. Since the initial features will be provided to support en route A/G communications system improvements, the majority of applications and benefits for operators and users will be attained there. Additional features may be identified for terminal and tower operations as the transition and system implementation evolve.

Text continues on page 5-15.

Figure 5-2. Transfer of Communications Example

Figure 5-3. Stuck Microphone Example

Figure 5-4. Clipped and Blocked Transmissions Example

Figure 5-5. Selective Addressing Example

Figure 5-6. Link Failure Detection and Correction Example (Phantom Controller--RFI Jammer)

Figure 5-7. Link Security Example
(Phantom Controller--"Spoofer")

Figure 5-8. Aircraft Identification/Caller ID Example

Figure 5-9. Pilot Urgent Message Indicator Example

Figure 10 -- Channel Contention Limitor

5.4 User Roles & Guiding Principles

The future A/G communications system will be developed from the requirements and desires of the NAS operators and users based upon the capabilities they believe they need to perform their roles. To this end, a number of guiding principles have been established to direct the development of the future digital A/G communications system. These include the following:

- An overall objective for the system will be to improve safety.
- Simultaneous voice and data transmissions over VHF radios will be provided for in the NAS.
- Minimize costs to airborne radio units will be a system goal.
- The ground infrastructure will have a worldwide applicability.
- Future voice communications will emulate existing PTT capabilities.
- Ground station radio range will be maintained or improved.
- The new system will minimize circuit blockage (stuck microphone) and contention.
- The system will include security measures to deter unauthorized users (phantom controllers).
- Controller and pilot utility of the system will be increased and workload will be reduced.
- For ease of transition, full system realization of the system will be attained in phases where, initially, the current system will coexist with the new system.
- Communications capacity will increase to at least twice that of today's system.
- VHF A/G voice and data communications will be available in both request/reply and broadcast modes.
- The system will provide functionally simultaneous data and voice communications from the same avionics unit.

5.5 Domestic Operations Versus International Operations

The information required to complete this section is currently under development by the FAA and other organizations, including RTCA and ICAO. Once key decisions relevant to the future role of the VHF A/G system have been made, the new information will be incorporated as part of this element of the operational concept.

5.6 Operational ATC and Pilot Scenarios

Development of operational scenarios describing the capabilities available to the operators (controllers and specialists) and the users (pilots) provide the best method of visualizing the future concept of operations for controllers and pilots using the VHF A/G communications system. The following sections describe what the system does and how it supports air-to-ground communications.

The scenarios are presented in the following order:

(1) A/G communications system operators (ATC), including all operational domains (Section 5.6.1)

(2) A/G communications system users (pilots), including all operational domains (Section 5.6.2)

Specific features envisioned will support the operational scenarios. These features have been introduced in Section 5.3. The planned use of the features is applied as part of the descriptions provided for both the controller/operator scenarios and the user scenarios.

5.6.1 Controller/Operator ATC Scenarios

ATC operational scenarios are provided for the tower/airport surface domain, terminal area domain, en route domain, oceanic domain and for flight services and other operational modes. Each domain includes a description of the controller activities supported by the future system and identifies special features and capabilities which will improve operator efficiency, performance, and utility. A summary table of the features supporting the operator scenario is provided at the end of each domain description.

5.6.1.1 Tower/Airport Surface ATC

Tower controllers include the local, ground, flight data, and clearance delivery positions in the tower cab. The local controller is responsible for sequencing and separation of aircraft operating on the active runways. The ground controller is responsible for aircraft and vehicular traffic on the airport movement areas, such as the taxiways, ramp areas, and other airport surfaces. The flight data controller maintains and updates relevant information concerning the aircraft, weather, and ATC system status. The clearance delivery controller issues Instrument Flight Rules (IFR)/Visual Flight Rules (VFR) clearances and ensures the accuracy of flight plan data.

ATC operators in the tower domain will have improved automation tools, access to new weather products, new radar technology, and new digital communications switching systems. These tools, products, and systems will assist controllers in performing their primary function of airspace usage planning. In this environment a combination of manual and automated capabilities for A/G communications will exist. Given the nature of operations in the tower environment, many of the traditional voice communications activities will be performed through the use of automatic data link communications for routine and standard control instructions and information dissemination.

On the surface, particularly during the phase of operations prior to taxi, pilots receive FIS and ATS information and updates provided by the ground controller and/or the flight data/clearance delivery controller. New ATC system capabilities envisioned for the airport surface domain will include primarily improved navigation and surveillance capabilities to support surface movement operations. There are no significant requirements for advanced functions for communications to support airport surface operations.

Coordination among tower personnel and terminal and en route personnel will be more automated. Newly introduced workstations and communications equipment will permit routine control communications between ATC facilities to be conducted automatically within the tower facilities and between adjacent hand-off facilities. Verbal conversations conducted via telephone, telephone conference, or face-to-face will still occur, but with decreased frequency. Improved PTT and interphone capabilities for the transmission of routine data messages will reduce the need for verbal communications for hand-offs, boundary advisories, and general coordination activities between controller positions internal and external to the tower facility.

Digital voice communications will be supported by new ETVS equipment in the towers. In addition, the implementation of new products, such as data link broadcasts of ATIS and PDC, and new capabilities for data link transfer of weather products generated from the Integrated Terminal Weather System (ITWS), will reduce controller workload by eliminating the need for voice communications on congested frequencies for routine control instructions. The initial use of digital recording capabilities will lessen the workload of the controller. The controller will still solicit and provide information (for example, hazardous weather such as microburst, lightning, and wind shear) to pilots via VHF radio on a workload-permitting basis. Generally, these information updates will be provided to pilots using the VHF data link capability for operations in the tower area other than during the pilot's critical phase of flight. Users are still not confident that data link messages received in the cockpit inside the outer marker will be provided in such a way as to ensure that the pilot has ample time to receive, respond and react to a warning. For the near term, users need to have a dual VHF voice and data communications capability during critical phase of flight operations such as final approach to landing and takeoff. However, this dependency for primary and back-up voice communications may be reduced as data link services are introduced and utilized as a common operating practice.

Controllers in the tower environment respond to pilot requests for ATC information and weather information via VHF radio. In the future, most of the information requests will be made via VHF data link request/reply basis. Significant Meteorological Advisories (SIGMETs) or Center Weather Advisories, ATIS messages, general pre-departure procedures messages, and weather information focus on surface conditions and impacts to pilots during taxi and departure and will be provided on both broadcast VHF voice and data channels. Surface traffic depiction graphics generated by the Airport Surface Traffic Automation (ASTA) system may be automatically available to pilots during taxi over the VHF data link; otherwise, surface traffic advisories will be provided by the ground controller over the VHF voice radio.

Demands placed upon the voice frequencies in the tower area will be reduced through the evolution of new data link services. Frequency congestion, most common to the ground and local control positions, will be reduced through the increased use of VHF data link communications. These data link services will be introduced as both broadcast messages (ATIS, updates to wind and altimeter settings, etc.) and request reply (clearance delivery). In addition, new radio features will reduce the occurrence of blocked and stepped-on transmissions which often require multiple and repeat communications of control instructions and information dissemination. Further, the TDMA capabilities will provide for a more efficient use of the existing tower frequencies and may provide for additional frequency allocations in areas experiencing very high demand for both voice and data link communications.

Figures 5-11 and 5-12 illustrate how controllers will apply new A/G communications system features for tower operations.

Figure 5-11. Applications of ATC Tower Communications Features

Insert Figure 5-12

Table 5-2 summarizes the operations of tower controllers and illustrates the envisioned distribution of voice and data communications using the digital VHF system.

Table 5.2. Future Tower/Surface VHF A/G Communications

Control Function/Operation	Manual	Primarily Manual/Partially Automated	Partially Manual/Primarily Automated	Automated
Severe Weather Advisories		u		
Routine Weather Advisories				n
Routine Taxi Information				t
ATIS				t
Routine Hand-Offs				n
Routine Interfacility Communications			n	
Routine Intrafacility Communications			n	
Pre-Departure Clearances			n	
Takeoff Clearances			n	
Taxi & Hold Short Clearances		n		
Landing Instructions			n	
Landing Clearances	u			
Traffic Management Information			n	
Transfer of Radio Communications			n	
Wake Turbulence Instructions		u		

Flight Plan Amendments		n		
Traffic Advisories	u			

Legend:

t Primarily VHF Data Link Broadcast
n Primarily VHF Data Link Request/Reply
u Primarily VHF Voice

Controller involvement in routine information transfers will be measurably reduced. Tower and terminal area pilots will automatically receive over the digital VHF A/G communications system routine textual and graphics products and advisories, without controller intervention. When an aircraft is not data link-equipped, information will continue to be disseminated via VHF radio.

Tower controllers are required to request Pilot Reports (PIREPs) from pilots to ensure that at least one is obtained per hour when the ceiling is at or below 5,000 feet. The future A/G communications system will be used to automatically request PIREPs from data link-equipped aircraft before the aircraft leaves tower airspace or control is transferred to the TRACON or adjacent facility. For non-data link aircraft, controllers will request PIREPs using the VHF voice radio. PIREPs will be provided via interphone or data message from the tower to other facilities.

5.6.1.2 Terminal ATC

Terminal ATC is provided by TRACONs and non-radar approach control facilities at medium to large hub airports. Terminal controllers provide separation and sequencing of aircraft, including arriving and departing aircraft, in and around the airport terminal area. Each terminal area is unique by design and procedure and differs in the number of controllers, controller assignments, traffic operations and equipment used to perform the operations. This section describes a "typical" terminal area digital VHF air/ground communications system.

Each radar position is assigned a defined segment of airspace near the terminal area, with appropriate graphical maps on the automated display. Generally, radar controller positions are designated for approach or departure aircraft control. The ATC separation applied to the individual aircraft is dependent upon the meteorological conditions relating to ceiling height and visibility at the airport and other factors, such as runway acceptance rates, runway occupancy times, wake vortex, wind shear and microburst phenomena. The controller relays information, issues control instruction and provides separation and sequencing via the use of the A/G radio. Some of these communications, nearly half, will be conducted via VHF data link. For A/G communications in critical phases of flight, these transmissions will continue to be provided over VHF voice; however, over time a transition to primarily data link communications is anticipated as pilots and controllers become more familiar with the data link services.

Figures 5-13 and 5-14 illustrate how controllers will apply new A/G communications system features for terminal area operations.

Text resumes on page 5-21.

INSERT FIGURE 5-13 HERE

INSERT FIGURE 5-14 HERE

Table 5-3 summarizes the operations of terminal area controllers and illustrates the envisioned distribution of voice and data communications using the digital VHF system.

Table 5.3. Future Terminal VHF A/G Communications

Control Function/Operation	Manual	Primary Manual/Partially Automated	Partially Manual/Primarily Automated	Automated
Severe Weather Advisories		u		t
Routine Weather Advisories				t
Routine Hand-Offs				n
Routine Interfacility Communications			n	
Routine Intrafacility Communications			n	
Traffic Management Information			n	
Transfer of Radio Communications				n
Flight Plan Amendments		n		
Traffic Advisories	u			

Legend:
t Primarily VHF Data Link Broadcast
n Primarily VHF Data Link Request/Reply
u Primarily VHF Voice

5.6.1.3 En Route ATC

En route ATC operations are provided by controllers and specialists located in ARTCCs, including Flight Data Controllers, Radar Controllers, Radar Associate/Non-Radar Controllers, Traffic Management Unit (TMU) Specialists and Coordinators. Controllers working the flight data position assist other en route controllers by providing information and coordination of flight plans, weather information, and other NAS/ARTCC status information. Radar controllers provide ATC clearances and instructions to aircraft operating within a designated sector of airspace by issuing altitude, heading, route, and airspeed instructions to keep aircraft separated from other aircraft and special use airspace in conformance to separation standards. Radar controllers issue and request weather information from pilots on a workload-permitting basis. The radar associate/non-radar position provides updates to flight progress strips and manual separation of aircraft outside of ARTCC/sectors radar coverage. TMU coordinators assess the capacity and demand for the airspace and airports within the ARTCC boundary; collect, disseminate and evaluate weather conditions and information; and coordinate implementation of any required traffic flow control restrictions necessary for radar controllers to ensure traffic demand does not exceed capacity in the airspace or at airports within the ARTCC boundary.

En route controllers assume control of the aircraft once it has left the terminal area from airports adjacent to ARTCC airspace boundaries and maintain control of the aircraft until the flight leaves ARTCC airspace and is handedoff to another ARTCC, TRACON or ATCT facility. Since ARTCC boundaries are large and encompass thousands of square miles of airspace, the impacts of traffic demands and weather to operations within ARTCCs are significant.

Currently, the demand for voice radio communications in high altitude airspace within ARTCCs exceeds capacity in many areas. The future en route environment will be characterized by a higher level of automation, new radar technology, new navigational technology, new weather products generators and advanced digital communications systems. These capabilities will provide significant reductions to the number of voice communications requirements. Controller workload will be reduced through the ability to use VHF channel selection features to perform routine communications tasks, including automatic and manually initiated transfer of radio frequency control to adjacent sectors within the ARTCC airspace; automatic uplink of routine weather advisories and information; improved "party-line" A/G communications; and reduced cases of pilot/controller communications errors in areas of stuck microphone, hearback/readback, simultaneous and clipped transmissions.

The digital A/G communications system will provide for VHF data link--one of the most significant technological advances to improve efficiency of controller and pilot operations en route. With the VHF data link capabilities, routine ATC instructions, NAS information, weather products and information will be provided to the pilots automatically in textual or graphic format without the need for voice communications. Duties performed manually in the current system on a workload permitting basis, (generally in the provision of weather and VFR traffic flight following) will be performed automatically and information will be disseminated to the cockpit without controller intervention. The automatic dissemination of weather products on a data link broadcast or request/replay basis will reduce both controller and pilot workload, thereby allowing them to devote more attention to their primary duties.

Controller workstations will be upgraded with enhanced software and communications systems which will allow controllers to access a wider range of information for transmission to aircraft, through the use of periodic broadcasts (either voice or data) of information of interest to all pilots on a frequency channel. Automatic requests for PIREPs (made by either a controller to the pilot or by the pilot to the controller) will be generated to improve situational awareness. Data link services will be expanded as additional aircraft become data link-equipped. With the expansion, en route controllers will no longer be the conduit of weather information to pilots.

Controllers will have the capability to uplink messages directly to the cockpit to initiate primary control instructions, transfer of control, and routine information, such as altimeter setting and transponder codes. Aircraft identification will automatically be displayed to the controller as soon as a voice or data message is initiated from the cockpit. This "caller ID" feature will assist the controller in prioritizing communications and managing aircraft more efficiently by eliminating the need to repeat initial radio contacts. Controllers working positions adjacent to terminal areas will be able to provide automatic communications transfer of the aircraft, either through the use of a data link message, or using the avionics radio capability to automatically select the required channel or frequency as the aircraft passes through ARTCC sectors. During the transition between terminal and en route airspace, several new VHF data link features will reduce the need for voice communications, including automatic uplinks (in a request/reply or broadcast mode) of ATIS information to all aircraft operating within designated sectors adjacent to terminal areas, concurrent with the transfer of control of the aircraft to the terminal facility. This feature will eliminate the need for pilots whose primary radio is tuned to the new ATC communications frequency.to tune a second radio to obtain the ATIS message.

Figures 5-15 and 5-16 illustrate how controllers will apply new A/G communications system features for en route operations.

INSERT FIGURE 5-15

INSERT FIGURE 5-16

Table 5-4 summarizes the operations of en route controllers and illustrates the envisioned distribution of voice and data communications using the digital VHF system.

Table 5.4. Future En Route VHF A/G Communications

Control Function/Operation	Manual	Primary Manual/Partially Automated	Partially Manual/Primarily Automated	Automated
Severe Weather Advisories				t
Routine Weather Advisories				t
Routine Hand-offs				n
Routine Interfacility Communications			n	
Routine Intrafacility Communications			n	
Traffic Management Information			n	
Transfer of Radio Communications				n
Flight Plan Amendments			n	
Traffic Advisories		n		

Legend:
t Primarily VHF Data Link Broadcast
n Primarily VHF Data Link Request/Reply
u Primarily VHF Voice

5.6.1.4 Oceanic ATC

For the purposes of this future VHF A/G communications concept, the oceanic communications system relative to VHF communications will remain essentially unchanged. For the 1995-1997 timeframe, the following avenues for communication between the aircraft and ATC will be in use in oceanic airspace. The particular method used will depend primarily on the level of user equipage.

- For satellite communications (SATCOM)-equipped aircraft, direct data link between aircraft and controller, with HF or satellite voice as back-up, will be used. If the data communications between the controller and pilot fail, a satellite phone patch may be used. As a further back-up, pilots will be able to contact a ground operator by HF data link, HF voice or satellite voice, which will then be relayed to the controller over the ARINC-Controller Data Communications System.

- For non-SATCOM-equipped aircraft, HF voice will be used to communicate with the aircraft where the communications data link will be established only between the controller and a ground operator.

Aircraft with satellite communicationsand data link equipment will send position reports via ADS, and non-ADS aircraft will report positions by HF radio or satellite voice to a communications service provider, who will relay the information to the appropriate oceanic facility. The ultimate future A/G communications system will provide the capability for direct two-way controller-to-cockpit data and voice communications for SATCOM-equipped aircraft. For most cases, the primary mode will be HF voice or data link through a communications service provider.

Routine oceanic A/G communications will include primarily flight progress updates and reporting, flight plan changes, transfer of control, route clearances, and flight monitoring. Replies to both data and voice requests from pilots will be generated by the controller and sent directly to the aircraft on either a terrestrial or satellite link. The pilot confirms instructions, clearances, and other ATC-generated communications via data link or voice message to the controller. In the case of flight plans and clearance confirmation, data link-equipped aircraft will automatically transmit to ATC the contents of the Flight Management System (FMS) database after the flight plan has been changed. Confirmation messages will be automatically sent to ATC once the new altitude, speed and/or route have been reached.

Where commensurate functionality exists in an adjoining facility, the capability to automatically exchange data between adjacent Flight Information Regions (FIRs) will be implemented. This will allow the automation systems to obtain flight plan data as well as flight progress information for aircraft which are outside of the FIR's airspace but will eventually be entering it. For those FIRs that will not have automated systems, the existing voice and back-up teletype capabilities will be used.

Envisioned A/G oceanic communications are illustrated in Figure 5-17. Applications of the VHF A/G oceanic communications system are illustrated as Figures 5-18 and 5-19.

Text continues on page 5-33.

Figure 5-17. Oceanic Communications System Description

INSERT FIGURE 5-18 HERE

INSERT FIGURE 5-19 HERE

5.6.1.5 Flight Services

The future A/G communications system will support two AFSS/FSS operational positions: the In-Flight Briefing Specialist (IFBS) and the En Route Flight Advisory Service (EFAS) specialist. The IFBS provides A/G communications of a routine or emergency nature. Routine services provided include pilot weather briefings; position reporting; flight following; and flight plan filing, activation, revision, and closure. Emergency services are provided in the form of orientation of lost aircraft. The EFAS specialist provides timely and accurate weather advisories to en route pilots anticipating the possibility of encountering marginal weather along the route of flight and assists in the circumnavigation of hazardous weather. Both the IFBS and the EFAS specialists will communicate via VHF voice as a primary means of communications for emergency situations and for all non-data link-equipped aircraft. The use of VHF data link for the handling of weather updates, flight plan filing, modifications and closures, position reporting, and other routine services will increase as the general aviation fleet equipage grows and data link services are implemented throughout the NAS.

The role of the flight service specialist will change significantly over the next ten years. The primary FSS/AFSS role related to the A/G communications system will be to provide in-flight weather advisories and direction finding capabilities to pilots en route. In remote and rare cases, the in-flight specialist may provide pre-flight weather services to pilots over the voice radio while the aircraft is on the ground. Initially, the EFAS position will remain at the AFSS/FSS facility. In the year 2003, the EFAS position will be moved to the ARTCC so that specialists will have access to new automated systems available at the ARTCC facility. This relocation is planned to provide specialists and pilots with more timely processing and handling of PIREPs and exchange of weather information. It is envisioned that the EFAS capability resident at the ARTCC will provide additional benefits by reducing radar controller workload in handling VHF radio and data link requests from pilots for routine weather updates.

The features provided by the digital VHF A/G communications system for EFAS or in-flight services communications are illustrated as Figure 5-20.

The specialist in the EFAS position at the FSS/AFSS prepares broadcasts for use by pilots. The preparation of these broadcasts will be partially automated through the use of Automatic High Altitude In-Flight Weather Advisory Service (Auto-HIWAS). The traditional Transcribed Weather En Route Broadcast (TWEB) will be consolidated with HIWAS in the future.

Specialists will generate weather briefings using new automation tools and weather products tailored specifically to the route of flight and destination. As additional aircraft are equipped with data link, specialist involvement in the dissemination of information over VHF voice channels will decrease as information and products will be provided directly to the pilot from weather products generators.

INSERT FIGURE 5-20

Table 5-5 summarizes the operations of the in-flight service/EFAS specialist and illustrates the envisioned distribution of voice and data communications using the digital VHF system. Specific flight information services for data link are still being developed and will likely expand as new weather products and systems are developed.

Table 5.5. Future Flight Services VHF A/G Communications

Control Function/Operation	Manual	Primary Manual/Partially Automated	Partially Manual/Primarily Automated	Automated
Severe Weather Advisories (HIWAS)		t		
Routine Weather Advisories				n
En Route Flight Plans			n	
Prepare Recorded Weather Broadcasts			n	
In-Flight Briefings			n	
Flight Following			n	
Position Reporting			n	
NOTAMs		n		
Direction Finding			n	
PIREPs		n		

Legend:
t Primarily VHF Data Link Broadcast
n Primarily VHF Data Link Request/Reply
u Primarily VHF Voice

5.6.1.6 National Traffic Flow

Once key decisions relevant to the future role of the VHF A/G system in the national traffic management domain have been made, the new information will be incorporated as part of this element of the operational concept.

5.6.2 User Scenarios

A general user scenario is provided to establish important scenario elements. This template provides a typical description of a commercial flight mission and a general aviation flight mission as it would be conducted within the new digital VHF system. For each generic mission, a brief description of the aircraft, communications avionics equipage, and other potential hardware options (generally applied to message or graphics displays) will be described first. Next, the basic information about the sample scenarios will be described, followed by a narrative of the mission with focus on the use and applications of the new A/G communications system capabilities.

The user template is established as the foundation to provide detailed description of the features of the A/G communications system by operational domain. A summary table is provided at the end of each domain subsection to illustrate the differences between use of future A/G communications system features by user category. Until transition planning is complete, it is not possible to illustrate the applications and features by user by domain over time. This representation is to be provided in Section 6.0.

The two operational user scenarios are described below.

(1) Commercial Air Transport Scenario

The aircraft is a large twin-engine turbofan aircraft planning an east to west coast flight between two large hub airports. The aircraft is equipped with a dual communications set capable of VHF voice and data, a Mode S data link set, and a third back-up emergency VHF voice communications radio.

The VHF data link interface is a dedicated color screen display mounted on the side panel of each pilot position. The data link processor is also interfaced with the Flight Management System (FMS) and the Electronic Flight Instrument System (EFIS) Horizontal Situation Display (HSD). A cockpit printer is also available to print text or graphic messages.

The crew arrives at the station operations office approximately one hour prior to scheduled departure. The flight paperwork--flight plan, takeoff performance calculations, planned weather and NOTAMs for the departure, en route, and arrival stations--is available for review. The crew notes that the rain showers that they encountered on the way to work are the result of a small stationary line of thunderstorms extending north/south west of the field along the standard departure routing. They expect departure delays. Once past this local area, the first part of the flight should be in clear skies with a smooth ride. Further west, some thunderstorm activity is expected over the Plains states later in the period, but it is difficult to determine if it will have any effect on the flight. Weather at the destination is forecast to be near Category II (CAT II) conditions, with a low ceiling and visibility restricted by fog. The projected departure time falls during a peak departure rush at the departure airport. Pilots anticipate a ground delay and expect to receive several flight plan routing amendments prior to takeoff.

The flight crew approves the proposed flight plan provided by flight dispatch. The flight plan is automatically filed with ATC.

Once the crew arrives at the aircraft, the crew request the active runway, current winds, temperature, dew point, visibility, cloud coverage/ceiling, altimeter setting, and facility NOTAMs using the VHF data link radio. In addition, the graphical precipitation depiction display in the cockpit shows thunderstorms in the terminal area. The appropriate route, aircraft performance, and selected upper atmosphere wind and temperature data are uplinked into the FMS.

Upon requesting the ATC clearance (via VHF data link), the crew is informed that outbound traffic is being delayed by the local thunderstorms, and the flight is issued an expected departure time more than an hour later than the scheduled departure. Flight Dispatch is contacted to determine if an earlier departure may be negotiated with ATC since the outbound route is clear of weather. Shortly thereafter, the delay is lifted (notification is received via VHF data link) and the crew initiates the departure process by requesting an updated departure clearance which is downloaded to the cockpit. A push-back clearance is sent by the ground controller and the crew initiates taxi.

Taxiing to the runway for takeoff, an update to the VHF broadcast ATIS message and a downlinked map from the Integrated Terminal Weather System (ITWS) show some microburst activity north of the departure path. However, it will not prevent takeoff; the crew follows the prescribed precautionary procedures and departs.

Approaching the area of expected turbulence near the jet stream, the crew requests the graphical jet stream and turbulence pictures. Three-dimensional graphics of the jet stream, and both forecast and actually-encountered turbulence provide an accurate view of what might be expected. Overlaying the flight plan route onto these pictures shows that the aircraft can reduce the headwind component as well as avoid the areas of greatest potential turbulence by deviating very slightly south of course. No change from optimum cruise altitude is required. The change in route will be requested and approved by ATC using the request/reply VHF data link service. While the aircraft is en route, the wind and temperature forecast for the upper atmosphere have been reissued and uplinked to the aircraft via VHF data link. Based on this update, the FMS suggests a climb to a higher cruise altitude for optimum fuel efficiency. A downlink request to ATC is made and approved.

Nearing the Plains states, ATC indicates that Convective SIGMET has been issued for the area ahead. The desired routing is requested via data link and approved by ATC. As the aircraft transits the hazardous weather area, the onboard weather radar is used to avoid the convective cells by the appropriate margins. Turbulence reports are downlinked to the en route controller position as required. The controller initiates a broadcast voice and data link message advising aircraft of the turbulence.

Approaching the destination, the crew requests the destination weather and traffic. Flight Dispatch responds with the weather information, RVR, and a report of the average delay encountered by other aircraft inbound. An airborne hold is anticipated. Having entered the terminal area and having been assigned a holding pattern, the crew monitors the terminal weather, with automatic uplinks. The crew has also selected automatic RVR updates from ATS/FIS datalink service, to assess the legality of making an approach.

Once released from the holding pattern in transit to the airport, the crew continues to monitor the RVR for changes below the legal limit.

(2) General Aviation Scenario

In this scenario, a general aviation single pilot IFR operator flies cross country from a controlled high-density airport in the Eastern Region to a medium-density airport in the Southern Region. The pilot has requested a direct routing from departure to destination. The pilot is operating a high-performance, single-engine aircraft equipped with a dual navigation/communications radio capable of VHF voice and data communications. The cockpit display includes a panel-mounted text-only display with two-color visualization capability. The aircraft is a four-place retractable gear piston airplane operating at 190 knots True Air Speed (TAS). The aircraft will fly approximately 600 miles in approximately 4 hours at an altitude of less than 12,000 feet. There is a weak cold front approximately 100 miles south/southwest of the route of flight and the weather and ceiling along the route of flight is forecast to be mixed VMC and IMC.

During the flight planning, the pilot decides that if the frontal activity moves to within 50 miles of the route of flight, the mission will divert to a contingency airport along the route of flight. The pilot intends to use the graphical weather radar precipitation depiction during the flight to monitor frontal conditions.

Should the front move into the area earlier than forecasts predict, the new route of flight requires the pilot to cross through terminal airspace on the west side of a busy, medium-hub airport during a peak inbound traffic period at an altitude which may conflict with inbound traffic. The pilot intends to monitor approach control frequency as soon as range permits to avoid a delay and request an alternate altitude assignment to meet the mission-critical arrival time.

Given the uncertainties in regard to anticipated weather and the likely event of a change to his flight plan (route of flight), the pilot plans for but does not file an alternate route and will provide ATC with PIREPs during the en route phase of flight. As the pilot is unfamiliar with the airport destination approach procedures, he plans to request from ATC, prior to entering terminal airspace, an uplink of routine arrival procedures. in addition to obtaining ATIS broadcast information. Since the destination airport is a medium-density airport and weather conditions are forecasted to be VFR upon arrival, the pilot elects to cancel the IFR flight plan and requests a visual approach.

Each of the scenarios will be applied to the operational domains in the following sections to illustrate the user mission mapped to the future A/G communications system capabilities and features which will support the conduct of the flight through the NAS. Given uncertainties in the level of fleet equipage, differing and unique operating practices between the general aviation users and the commercial users, and uncertainties driven by transition to the full implementation of the digital VHF system, there will naturally be an evolutionary approach to implementing the digital A/G communications system.

It is likely that user needs will be met first for operators using the high altitude en route and oceanic airspace and that benefits and capabilities will "trickle down" to terminal and tower operations over time. The drivers for change influencing the implementation of digital voice and data communications for the high altitude users include inadequate frequency allocations, frequency congestion, lack of wide-scale avionics equipage within the total aircraft fleet, and areas of widespread communications problems within this airspace. Some tower and terminal areas may realize mid-term benefits as a result of forecasted demands for frequencies and inadequate capacity within the terminal area frequency spectrum.

The transition strategy for the future digital A/G communications system is introduced in Section 4.0 and described from the operational perspective in Section 5.8.

5.6.2.1 Tower/Airport Surface Operations

In the future, most pilot information requests will be made via VHF data link request/reply basis. SIGMETs or Center Weather Advisories, ATIS messages, general pre-departure procedures messages, and weather information focus on surface conditions and impacts to pilots during taxi and departure and will be provided by ATC on both broadcast VHF voice and data channels. Surface traffic depiction graphics generated by the Airport Surface Traffic Automation system may be automatically available to pilots during taxi over the VHF data link; otherwise, surface traffic advisories will be provided by the ground controller over the VHF voice radio.

Figures 5-21 and 5-22 illustrate how pilots will receive ATC communications using the new A/G communications system features for tower and airport surface operations.

INSERT FIGURE 5-21 HERE

INSERT FIGURE 5-22

5.6.2.1.1 Commercial Air Transport Users

When the aircraft is in position to begin its final approach, the pilot makes contact with the local controller via VHF voice or data link after the transfer of control message is received from the terminal approach control facility. The initial communications from the local controller include either a voice or data link message providing wind conditions and other necessary ATC instructions necessary for a safe landing. The ATIS broadcast will be automatically provided by both VHF voice and data link from the terminal approach controller prior to hand-off to the tower. Landing clearances and control instructions, RVR, and runway and airport surface winds, will be provided by either VHF voice or data link to the pilots as the primary source of information during the final approach to landing phase. Traffic advisories and alerts will be provided via the VHF voice channel initially, and traffic advisories may be provided via data link later in the A/G communications system transition phase as users become more confident and reliant upon the data link capabilities. It is possible that traffic alerts will be provided via VHF data link for commercial users as a complement to onboard Traffic Alert and Collision Avoidance System (TCAS) capabilities; however, in significant situations of seriously compromised separation, the primary A/G communication will be via VHF voice radio channels.

For non-data link-equipped commercial aircraft, pilots will continue to receive the arrival clearances and information described above via digital VHF voice communications.

5.6.2.1.2 General Aviation Users

The operations for general aviation during the arrival phase are very similar to those described for the commercial operators. When the aircraft is in position to begin its final approach, the pilot makes contact with the local controller, via VHF voice or data link after the transfer of control message is received from the terminal approach control facility. The initial communications from the local controller include either a voice or data link message providing wind conditions and other necessary ATC instructions necessary for a safe landing. The ATIS broadcast will automatically be provided by both VHF voice and data link from the terminal approach controller prior to hand-off to the tower. Traffic advisories and alerts will be provided via the VHF voice channel initially, and traffic advisories may be provided via data link later in the A/G communications system transition phase as users become more confident and reliant upon the data link capabilities. It is unlikely that traffic alerts will be provided via VHF data link for general aviation applications. Landing clearances and control instructions, as well as runway and airport surface winds, will be provided by either VHF voice or data link to the pilots as the primary source of information during the landing phase.

For non-data link-equipped general aviation aircraft, pilots will continue to receive the arrival clearances and information described above via digital voice communications.

5.6.2.2 Terminal Operations

Terminal area pilots include domestic and international air carrier pilots, air taxi and commuter pilots, military pilots and general aviation pilots. Pilots operating in the terminal area are primarily responsible for the safe operation of the aircraft while arriving at or departing from the airport. The terminal area pilot typically receives airport information, general procedures, and weather information during the descent phase of flight. Information necessary for terminal departures is generally provided by the tower controller.

Figures 5-23 and 5-24 illustrate how pilots will receive ATC communications using the new A/G communications system features for terminal area operations.

INSERT FIGURE 5-23 HERE

INSERT FIGURE 5-24 HERE

5.6.2.2.1 Commercial Air Transport Users

Upon entering the arrival airport terminal airspace, the pilot requests via data link the ATIS and current weather conditions. The TRACON approach controller advises the pilot (or automatically transfers the pilot request) to contact the EFAS specialist on a different frequency for convective SIGMETs. These communications are made via VHF data link. The EFAS specialist uplinks the weather radar depiction and SIGMET information to the pilot, who contacts the EFAS specialist on the VHF voice channel to request clarification of the weather situation. During this communication, the co-pilot prepares a PIREP, as conditions are actually worse than forecast and depicted at approach altitude, and downlinks the message to the EFAS specialist. The pilot then manually engages the channel selector and sends a "with you" message to the TRACON approach controller. Since airport conditions for this flight scenario are poor, the approach controller issues braking action, RVR information, and an approach clearance (including airport winds, altimeter setting and other clearance instructions) to the pilot using VHF data link. The pilot receives the message, downlinks a "will-comply/WILCO" reply and selects the tower frequency on the VHF radio. The pilot initiates a VHF voice communication to the local controller and receives a landing clearance. The controller has uplinked reissued wind information, runway braking action and RVR which were provided automatically over the data link channel during the voice transmission of landing clearance.

5.6.2.2.2 General Aviation Users

General aviation services are essentially the same as those described for commercial operations. Upon entering the arrival airport terminal airspace, the pilot requests via data link the ATIS and current weather conditions. The TRACON approach controller advises the pilot (or automatically transfers the pilot request) to contact the EFAS specialist on a different frequency for convective SIGMETs. These communications are made via VHF data link. The EFAS specialist uplinks the weather radar depiction and SIGMET information to the pilot, who contacts the EFAS specialist on the VHF voice channel to request clarification of the weather situation. The pilot manually engages the channel selector and sends a "with you" message to the TRACON approach controller. An approach clearance (including airport winds, altimeter setting and other clearance instructions) is provided to the pilot using VHF data link. The pilot receives the message, downlinks a "will-comply/WILCO" reply and selects the tower frequency on the VHF radio. The pilot initiates a VHF voice communication to the local controller and receives a landing clearance. The controller has uplinked reissued wind information during the voice transmission of landing clearance.

5.6.2.3 En Route Operations

The future en route operations are characterized by many new A/G communications capabilities, the most significant of which is the automatic frequency change selection within ARTCC boundaries. This feature reduces controller and pilot work load by providing an automatic frequency change of the VHF radio between ARTCC sectors and potentially between ARTCC facilities. This feature eliminates the need for multiple and radio-tuning tasks, reduces the chance of mis-tuning hand-off radio frequencies and provides for channel and frequency management optimization. While it is likely that pilots may desire to manually select radios during initial implementation of the digital system, over time the ability for the radios to automatically tune to the new frequency will be utilized on a wide-scale basis as pilots become familiar with the procedures and confident of their reliability, and as they experience workload-reducing benefits.

Figures 5-25 and 5-26 illustrate how pilots will receive ATC communications using the new A/G communications system features for en route operations.

INSERT FIGURE 5-25

INSERT FIGURE 5-26

5.6.2.4 Oceanic Operations

Oceanic voice and data link services will expand as additional aircraft become data link-equipped. With this expansion, dissemination of information and ATC instructions and the automatic downlinking of position reports will become virtually automated. Since typical users of the oceanic airspace maintain a higher degree of advanced equipment capabilities for operations overseas, both general aviation and commercial users will enjoy common services, features and benefits for oceanic flights. Pilot reports will be automated, relieving the pilots and controllers from many information dissemination responsibilities.

Satellite communications- and data link-equipped aircraft will send position reports via ADS, and non-ADS aircraft will report positions by HF or satellite voice to a communications service provider who will relay the information to the appropriate oceanic facility. The ultimate future A/G communications system will provide the capability for direct two-way controller-to-cockpit data and voice communications for SATCOM-equipped aircraft. For most cases, the primary mode will be VHF voice or data link through a communications service provider.

Where commensurate functionality exists in an adjoining facility, the capability to exchange data automatically between adjacent FIRs will be implemented. This will allow the automation to obtain flight plan data as well as flight progress information for aircraft which are outside of the FIR's airspace but will eventually be entering it. For those FIRs that will not have automated systems, the VHF voice and back-up teletype capabilities will be used.

Figures 5-27 and 5-28 illustrate how pilots will receive ATC communications using the new A/G communications system features for oceanic operations.

The requirements, alternatives, and scenarios necessary to complete the description of other shoreline and extended over-water operations (for example those over the Gulf of Mexico) are currently under development by various organizations within the FAA. Once Agency planning has been completed and key decisions made, the new information will be incorporated as part of this element of the operational concept.

5.6.2.5 Flight Services

In the near-term, the AFSS will continue to provide en route advisory services to pilots from the EFAS position. Flight services will be simplified as a result of increased automation and availability of commercial services and products. A/G communications system support for en route weather information services will likely be provided from the relocation of the EFAS position to the ARTCC/ACF. This change to the facility of responsibility is planned to provide for the more timely processing of PIREPs and exchange of weather data. Generation of voice weather broadcasts over the VHF A/G communications system will be completely automated.

The relocation of the EFAS position to the ARTCC will allow frequencies now in use by AFSSs to be re-used for other ATC control functions. With the implementation of TDMA techniques, the resulting additional voice and data contacts to ARTCC frequencies can be accommodated and will most likely be handled more efficiently over a larger flight plan area consistent with the ARTCC airspace boundaries.

Figures 5-29 and 5-30 illustrate how pilots will receive ATC/EFAS communications using the new A/G communications system features for in-flight weather advisory services .

INSERT FIGURE 5-27 HERE

INSERT FIGURE 5-28 HERE

insert figure 5-29 here

insert figure 5-30 here

5.6.2.6 National Traffic Flow

Once key decisions relevant to the future role of the VHF A/G system in the national traffic management domain have been made, the new information will be incorporated as part of this element of the operational concept.

5.7 Operational Scenarios Flow

The information required to complete this section is currently under development by various organizations within the FAA. Once Agency planning has been completed and key decisions made, the new information will be incorporated as part of this element of the operational concept.

5.8 Support Scenarios

The information required to complete this section is currently under development by various organizations within the FAA. Once Agency planning has been completed and key decisions made, the new information will be incorporated as part of this element of the operational concept.

5.9 Maintenance Scenario

The information required to complete this section is currently under development by various organizations within the FAA. Once Agency planning has been completed and key decisions made, the new information will be incorporated as part of this element of the operational concept.

5.10 Training Scenario

The information required to complete this section is currently under development by various organizations within the FAA. Once Agency planning has been completed and key decisions made, the new information will be incorporated as part of this element of the operational concept.